

# Monel® 400

Material no. 2.4360 · NiCu30Fe · Nickel-copper alloy

**Material group:** Nickel-copper alloy (~67 % Ni, ~30 % Cu), corrosion resistant

**Material no. (EN):** 2.4360

**EN designation:** NiCu30Fe

**UNS / ASME:** UNS N04400

**Trade names:** Monel® 400, Nicorros® 4400, Alloy 400

**ASTM / ASME equivalent:** Pipes: B165 (seamless) / B725 (welded) · Fittings: B366 WPNC · Flanges: B564

**Service temperature:** -250 °C to +480 °C (continuous service)

**Standards (pipes):** EN 10216-5 · ASTM B165 / B725 · VdTÜV 263

**Standards (fittings):** EN 10253-4 · ASTM B366 WPNC

**Forms (Nirotec):** Elbows · tees · reducers · caps · flanges · custom parts

## 1 Material Equivalents & Comparable Grades

### National equivalents

Standard / region	Designation	Material no. / Grade	Remark
EN	NiCu30Fe	2.4360	Current European designation
UNS	Alloy 400	N04400	ASTM/ASME designation
DIN (old)	NiCu30Fe	2.4360	Identical, unchanged
ASTM/ASME	A/SA B165 / B725	UNS N04400	Seamless / welded pipes
ASTM/ASME	A/SA B366 WPNC	UNS N04400	Buttweld fittings
ASTM/ASME	A/SA B564	UNS N04400	Forgings, flanges
Trade names	Monel® 400, Nicorros® 4400	–	Common trade names

### Alternative materials

Material	Material no.	Reference / use	Note
Monel K-500 / 2.4375	2.4375	Precipitation-hardened, much higher strength	Higher-strength applications
Cupronickel 70/30 / 2.0882	2.0882	Lower cost, similar marine service	Heat exchangers, seawater
Hastelloy C-276 / 2.4819	2.4819	Better in oxidising acids	Mixed-acid environments

Material	Material no.	Reference / use	Note
Inconel 625 / 2.4856	2.4856	Higher strength, oxidising resistance	Combined load + chemical exposure

## 2 Chemical Composition

Composition in mass percent (%). Standard: ASTM B127 / B164 / VdTÜV 263. Monel 400 is a single-phase nickel-copper solid solution alloy with outstanding resistance to seawater, hydrofluoric acid and reducing media.

Element	Symbol	Min. (heat)	Max. (heat)	Max. (product)	Function / remark
Nickel + Cobalt	Ni+Co	63.0	–	–	Matrix (~67 %)
Copper	Cu	28.0	34.0	34.0	Cu-Ni solid solution
Iron	Fe	–	2.5	2.5	Limit
Manganese	Mn	–	2.0	2.0	Limit
Carbon	C	–	0.30	0.30	Limit
Silicon	Si	–	0.50	0.50	Limit
Sulfur	S	–	0.024	0.024	Impurity limit

## 3 Mechanical Properties

### Annealed condition – minimum requirements (ASTM B165 / VdTÜV 263)

Property	Symbol	Unit	Minimum value	Remark
Yield strength 0.2 %	Rp0.2	MPa	≥ 170	Annealed
Yield strength 0.2 %	Rp0.2	MPa	≥ 380	Cold-drawn, stress-relieved
Tensile strength	Rm	MPa	≥ 480	Annealed
Tensile strength	Rm	MPa	≥ 580	Cold-drawn
Elongation at fracture	A	%	≥ 35	Longitudinal, annealed
Impact energy (20 °C)	KV	J	≥ 100	Mean value
Hardness	HB	–	110 – 150	Reference value, annealed

### Hot yield strength Rp0.2 in MPa (typical values per standard)

Temperature	100 °C	200 °C	300 °C	400 °C	480 °C
Rp0.2 (MPa)	160	150	140	125	115

## 4 Physical Properties

Property	Symbol	20 °C	200 °C	400 °C	480 °C	Unit
Density	$\rho$	8.83	8.74	8.62	8.57	g/cm <sup>3</sup>
Modulus of elasticity	E	180	171	159	153	GPa
Thermal conductivity	$\lambda$	21.8	26.0	31.8	33.7	W/(m·K)
Coeff. thermal expansion	$\alpha$	13.9	14.7	15.8	16.2	10 <sup>-6</sup> /K
Specific heat capacity	cp	427	455	485	498	J/(kg·K)

## 5 Corrosion Resistance

Medium / environment	Remark	Resistance
Seawater (flowing)	Outstanding resistance, low corrosion rate	++
Hydrofluoric acid (HF)	Excellent – one of the few suitable materials	++
Reducing acids (HCl, H <sub>2</sub> SO <sub>4</sub> ) at low conc.	Good resistance	++
Alkalis (NaOH up to 80 %)	Excellent resistance	++
Sour gas (H <sub>2</sub> S)	NACE MR0175 qualified	++
Brine, salt solutions	Very good resistance	++
Oxidising acids (HNO <sub>3</sub> )	Not resistant – attack	-
Sulphur at high temperature	Not suitable	-
Stagnant seawater (crevices)	Possible crevice corrosion	o
Ammonia (NH <sub>3</sub> ) with O <sub>2</sub>	Stress-corrosion cracking risk	-

++ excellent resistance
+ good resistance
o limited resistance
- not resistant

Monel 400 is the classic material for marine applications and hydrofluoric acid – but not suitable for oxidising acids. The reverse profile of austenitic stainless steels.

## 6 Typical Applications

Industry / plant	Typical application	Operating condition
Marine / offshore	Seawater piping, valves, heat exchangers	Flowing seawater, brackish water
Hydrofluoric acid plants	Reactors, piping, columns	Anhydrous and aqueous HF
Chemical industry	Alkali plants, salt solutions	NaOH, KOH up to high concentrations

Industry / plant	Typical application	Operating condition
Petrochemical (sour service)	Sour-gas piping, wellhead components	NACE MR0175
Power generation	Feedwater piping, condenser tubes	Coastal / brackish water cooling
Aerospace / military	Fasteners, valve trim, exhaust components	Salt-spray environments

## 7 Forms Available at Nirotec

Component	Standard (EN)	Standard (ASME/ASTM)	Remark
Elbows	EN 10253-4	ASME B16.9 · B366 WPNC	LR/SR, custom angles on request
Tees	EN 10253-4	ASME B16.9 · B366 WPNC	Equal and reducing branch
Reducers	EN 10253-4	ASME B16.9 · B366 WPNC	Concentric and eccentric
Caps	EN 10253-4	ASME B16.9 · B366 WPNC	Hemispherical caps
Weld neck flanges	EN 1092-1 type 11	ASME B16.5 · B564	PN 10 – PN 250 / Class 150 – 1500
Custom parts	Per drawing	Per drawing	Custom geometries on request

## 8 Standards, Approvals & Codes

Standard / code	Title / application
EN 10216-5	Seamless pipes for pressure purposes – stainless and nickel-base alloys
EN 10253-4	Butt-welding fittings – austenitic and nickel-base alloys
EN 1092-1	Flanges and their joints
VdTÜV 263	NiCu30Fe (2.4360) – material data sheet
ASTM B165 / B725	Seamless / welded pipes – UNS N04400
ASTM B366	Factory-made wrought nickel-alloy fittings (WPNC)
ASTM B564	Nickel-alloy forgings
NACE MR0175 / ISO 15156	Materials for H <sub>2</sub> S-containing environments (sour service)
PED 2014/68/EU	Pressure Equipment Directive
ASME B31.1 / B31.3	Power / process piping

## 9 Processing Notes

### Weldability

Parameter	Specification / recommendation	Remark
Preheat	Not required	Room-temperature welding
Post-weld heat treatment	Generally not required	Stress relief 540–650 °C optional
Filler metal	ERNiCu-7 (AWS A5.14)	Matching Ni-Cu filler
Welding processes	GTAW (TIG), GMAW, SMAW	All standard processes suitable
Interpass temperature	≤ 150 °C	Standard practice

- Delivery condition: annealed (soft) or stress-relieved (cold-drawn)
- Cleanliness: free from sulphur-bearing contaminants before welding (sulphur embrittlement)
- Identification per ASTM B165: heat no., 2.4360 / UNS N04400, standard, dimensions
- Not suitable for use with anhydrous ammonia + oxygen (SCC risk)
- Excellent machinability among nickel alloys – similar to brass / bronze

## 10 Inquiry & Contact

For a project-specific inquiry we ideally require:

- Standard and type (e.g. ASTM B165 / B366 WPNC LR 90°)
- Dimensions: DN / NPS, wall thickness or schedule
- Quantity and required delivery date
- Required documentation (EN 10204 type 3.1 / 3.2, NDT, external inspection)
- Project-specific specification (NACE MR0175, marine class, etc.)

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